

2N7224, JANTX2N7224, JANTXV2N7224  
 2N7225, JANTX2N7225, JANTXV2N7225

2N7227, JANTX2N7227, JANTXV2N7227  
 2N7228, JANTX2N7228, JANTXV2N7228

## JANTX, JANTXV POWER MOSFET IN TO-254AA PACKAGE, QUALIFIED TO MIL-PRF-19500/592

100V Thru 500V, Up to 34A, N-Channel,  
 MOSFET Power Transistor, Repetitive Avalanche Rated

### FEATURES

- Repetitive Avalanche Rating
- Isolated and Hermetically Sealed
- Low  $R_{DS(on)}$
- Ease of Paralleling
- Ceramic Feedthroughs
- Qualified to MIL-PRF-19500

### DESCRIPTION

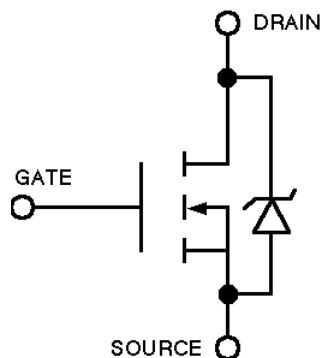
This hermetically packaged QPL product features the latest advanced MOSFET and packaging technology. It is ideally suited for Military requirements where small size, high performance and high reliability are required, and in applications such as switching power supplies, motor controls, inverters, choppers, audio amplifiers and high energy pulse circuits.



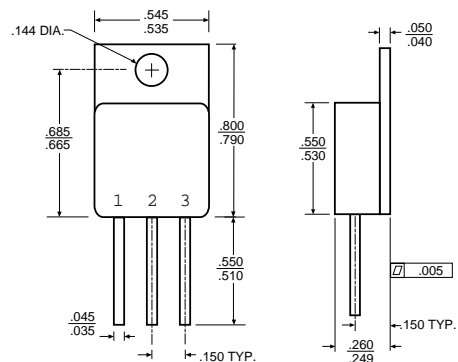
PRIMARY ELECTRICAL CHARACTERISTICS @  $T_c = 25\text{ C}$

PART NUMBER	$V_{DS}$ , Volts	$R_{DS(on)}$	$I_D$ , Amps
2N7224	100	.070	34
2N7225	200	.100	27.4
2N7227	400	.315	14
2N7228	500	.415	12

### SCHEMATIC



### MECHANICAL OUTLINE



Pin Connection  
 Pin 1: Drain  
 Pin 2: Source  
 Pin 3: Gate

2N7224, JAN1X2N7224, JAN1XV2N7224  
2N7225, JAN1X2N7225, JAN1XV2N7225

2N7227, JAN1X2N7227, JAN1XV2N7227  
2N7228, JAN1X2N7228, JAN1XV2N7228

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Parameter		JAN1XV, JAN1X, 2N7224	Units
$I_D$ @ $V_{GS} = 10\text{V}$ , $T_C = 25^\circ\text{C}$	Continuous Drain Current	34	A
$I_D$ @ $V_{GS} = 10\text{V}$ , $T_C = 100^\circ\text{C}$	Continuous Drain Current	21	A
$I_{DM}$	Pulsed Drain Current <sup>1</sup>	136	A
$P_D$ @ $T_C = 25^\circ\text{C}$	Maximum Power Dissipation	150	W
	Linear Derating Factor	1.2	W/ $^\circ\text{C}$
$V_{GS}$	Gate-Source Voltage	$\pm 20$	V
$E_{AS}$	Single Pulse Avalanche Energy <sup>2</sup>	150 <sup>4</sup>	mJ
$I_{AR}$	Avalanche Current <sup>1</sup>	34 <sup>4</sup>	A
$E_{ARR}$	Repetitive Avalanche Energy <sup>1</sup>	15 <sup>4</sup>	mJ
$T_J$	Operating Junction	-55 to 150	$^\circ\text{C}$
$T_{STG}$	Storage Temperature Range		$^\circ\text{C}$
	Lead Temperature	300(.06 from case for 10 sec)	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS @  $T_J = 25^\circ\text{C}$  (Unless Otherwise Specified)

Parameter	Min.	Typ.	Max.	Units	Test Conditions
$BV_{DSS}$ Drain-Source Breakdown Voltage	100			V	$V_{GS} = 0\text{V}$ , $I_D = 1.0\text{ mA}$ ,
$R_{DS(on)}$ Static Drain-to-Source On-State Resistance	—	—	0.07		$V_{GS} = 10\text{V}$ , $I_D = 21\text{ A}$ <sup>3</sup>
	—	—	0.081		$V_{GS} = 10\text{V}$ , $I_D = 34\text{ A}$ <sup>3</sup>
$V_{GS(th)}$ Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$
$I_{DSS}$ Zero Gate Voltage Drain Current	—	—	25	$\mu\text{A}$	$V_{DS} = 80\text{ V}$ , $V_{GS} = 0\text{V}$
	—	—	250		$V_{DS} = 80\text{ V}$ , $V_{GS} = 0\text{V}$ , $T_J = 125^\circ\text{C}$
$I_{SS}$ Gate -to-Source Leakage Forward	—	—	100	nA	$V_{GS} = 20\text{ V}$
$I_{SS}$ Gate -to-Source Leakage Reverse	—	—	-100	nA	$V_{GS} = -20\text{ V}$
$Q_{G(on)}$ On-state Gate Charge	—	—	125	nC	$V_{GS} = 10\text{ V}$ , $I_D = 34\text{ A}$
$Q_{GS}$ Gate-to-Source Charge	—	—	22	nC	$V_{DS} = 50\text{ V}$
$Q_{GD}$ Gate-to-Drain ("Miller") Charge	—	—	65	nC	See note 4
$t_{ON}$ Turn-On Delay Time	—	—	35	ns	$V_{DD} = 50\text{ V}$ , $I_D = 21\text{ A}$ , $R_G = 2.35$
$t_r$ Rise Time	—	—	190	ns	See note 4
$t_{OFF}$ Turn-Off Delay Time	—	—	170	ns	
$t_f$ Fall Time	—	—	130	ns	

Source-Drain Diode Ratings and Characteristics

Parameter	Min.	Typ.	Max.	Units	Test Conditions
$V_{SD}$ Diode Forward Voltage	—	—	1.8	V	$T_J = 25^\circ\text{C}$ , $I_S = 34\text{ A}$ <sup>3</sup> , $V_{GS} = 0\text{ V}$
$t_r$ Reverse Recovery Time	—	—	500	ns	$T_J = 25^\circ\text{C}$ , $I_R = 34\text{ A}$ , $di/dt \leq 100\text{ A}/\mu\text{s}$

Thermal Resistance

Parameter	Min.	Typ.	Max.	Units	Test Conditions
$R_{thJC}$ Junction-to-Case	—	—	0.83	$^\circ\text{C}/\text{W}$	Mounting surface flat, smooth, and greased
$R_{thCS}$ Case-to-sink	—	0.21	—		
$R_{thJA}$ Junction-to-Ambient	—	—	48		

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. @  $V_{DD} = 25\text{V}$ , Starting  $T_J = 25^\circ\text{C}$ ,  $L \geq 200\text{ }\mu\text{H}$ ,  $R_G = 25$ , Peak  $I_L = 34\text{ A}$
3. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; Duty Cycle  $\leq 2\%$
4. See MIL-S-19500/592

2N7224, JANTX2N7224, JANTXV2N7224  
2N7225, JANTX2N7225, JANTXV2N7225

2N7227, JANTX2N7227, JANTXV2N7227  
2N7228, JANTX2N7228, JANTXV2N7228

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Parameter	JANTXV, JANIX, 2N7225	Units
$I_D$ @ $V_{GS} = 10\text{V}$ , $T_C = 25^\circ\text{C}$ Continuous Drain Current	27.4	A
$I_D$ @ $V_{GS} = 10\text{V}$ , $T_C = 100^\circ\text{C}$ Continuous Drain Current	17	A
$I_{DM}$ Pulsed Drain Current <sup>1</sup>	110	A
$P_D$ @ $T_C = 25^\circ\text{C}$ Maximum Power Dissipation	150	W
Linear Derating Factor	1.2	W/ $^\circ\text{C}$
$V_{GS}$ Gate-Source Voltage	$\pm 20$	V
$E_{AS}$ Single Pulse Avalanche Energy <sup>2</sup>	500 <sup>4</sup>	mJ
$I_{AR}$ Avalanche Current <sup>1</sup>	27.4 <sup>4</sup>	A
$E_{AR}$ Repetitive Avalanche Energy <sup>1</sup>	15 <sup>4</sup>	mJ
$T_J$ Operating Junction	-55 to 150	$^\circ\text{C}$
$T_{STG}$ Storage Temperature Range		$^\circ\text{C}$
Lead Temperature	300(.06 from case for 10 sec)	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS @  $T_J = 25^\circ\text{C}$  (Unless Otherwise Specified)

Parameter	Min.	Typ.	Max.	Units	Test Conditions
$BV_{DSS}$ Drain-Source Breakdown Voltage	200			V	$V_{GS} = 0\text{V}$ , $I_D = 1.0\text{ mA}$ ,
$R_{DS(on)}$ Static Drain-to-Source On-State Resistance	—	—	0.100		$V_{GS} = 10\text{ V}$ , $I_D = 17\text{ A}$ <sup>3</sup>
	—	—	0.105		$V_{GS} = 10\text{ V}$ , $I_D = 27.4\text{ A}$ <sup>3</sup>
$V_{GS(th)}$ Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$
$I_{SS}$ Zero Gate Voltage Drain Current	—	—	25	$\mu\text{A}$	$V_{DS} = 160\text{ V}$ , $V_{GS} = 0\text{V}$
	—	—	250		$V_{DS} = 160\text{ V}$ , $V_{GS} = 0\text{V}$ , $T_J = 125^\circ\text{C}$
$I_{SSS}$ Gate -to-Source Leakage Forward	—	—	100	nA	$V_{GS} = 20\text{ V}$
$I_{SSS}$ Gate -to-Source Leakage Reverse	—	—	-100	nA	$V_{GS} = -20\text{ V}$
$Q_{G(on)}$ On-state Gate Charge	—	—	115	nC	$V_{GS} = 10\text{ V}$ , $I_D = 27.4\text{A}$
$Q_{GS}$ Gate-to-Source Charge	—	—	22	nC	$V_{DS} = 100\text{ V}$
$Q_{Gd}$ Gate-to-Drain ("Miller") Charge	—	—	60	nC	See note 4
$t_{(on)}$ Turn-On Delay Time	—	—	35	ns	$V_{DD} = 100\text{ V}$ , $I_D = 17\text{A}$ , $R_G = 2.35$ See note 4
$t_r$ Rise Time	—	—	190	ns	
$t_{(off)}$ Turn-Off Delay Time	—	—	170	ns	
$t_f$ Fall Time	—	—	130	ns	

Source-Drain Diode Ratings and Characteristics

Parameter	Min.	Typ.	Max.	Units	Test Conditions
$V_{SD}$ Diode Forward Voltage	—	—	1.9	V	$T_J = 25^\circ\text{C}$ , $I_S = 27.4\text{A}$ <sup>3</sup> , $V_{GS} = 0\text{ V}$
$t_r$ Reverse Recovery Time	—	—	950	ns	$T_J = 25^\circ\text{C}$ , $I_F = 27.4\text{A}$ , $di/dt \leq 100\text{A}/\mu\text{s}$

Thermal Resistance

Parameter	Min.	Typ.	Max.	Units	Test Conditions
$R_{thJC}$ Junction-to-Case	—	—	0.83	$^\circ\text{C}/\text{W}$	Mounting surface flat, smooth, and greased
$R_{thCS}$ Case-to-sink	—	0.21	—		
$R_{thJA}$ Junction-to-Ambient	—	—	48		

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. @  $V_{DD} = 50\text{V}$ , Starting  $T_J = 25^\circ\text{C}$ ,  $L \geq 1\text{ mH}$ ,  $R_G = 25$ , Peak  $I_L = 27.4\text{A}$
3. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; Duty Cycle  $\leq 2\%$
4. See MIL-S-19500/592

2N7224, JAN1X2N7224, JAN1XV2N7224  
2N7225, JAN1X2N7225, JAN1XV2N7225

2N7227, JAN1X2N7227, JAN1XV2N7227  
2N7228, JAN1X2N7228, JAN1XV2N7228

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Parameter	JAN1XV, JAN1X, 2N7227	Units
$I_D$ @ $V_{GS} = 10\text{V}$ , $T_C = 25^\circ\text{C}$ Continuous Drain Current	14	A
$I_D$ @ $V_{GS} = 10\text{V}$ , $T_C = 100^\circ\text{C}$ Continuous Drain Current	9.0	A
$I_{DM}$ Pulsed Drain Current <sup>1</sup>	56	A
$P_D$ @ $T_C = 25^\circ\text{C}$ Maximum Power Dissipation	150	W
Linear Derating Factor	1.2	W/ $^\circ\text{C}$
$V_{GS}$ Gate-Source Voltage	$\pm 20$	V
$E_{AS}$ Single Pulse Avalanche Energy <sup>2</sup>	700 <sup>4</sup>	mJ
$I_{AR}$ Avalanche Current <sup>1</sup>	14 <sup>4</sup>	A
$E_{AR}$ Repetitive Avalanche Energy <sup>1</sup>	15 <sup>4</sup>	mJ
$T_J$ Operating Junction	-55 to 150	$^\circ\text{C}$
$T_{STG}$ Storage Temperature Range		$^\circ\text{C}$
Lead Temperature	300(.06 from case for 10 sec)	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS @  $T_J = 25^\circ\text{C}$  (Unless Otherwise Specified)

Parameter	Min.	Typ.	Max.	Units	Test Conditions
$BV_{DSS}$ Drain-Source Breakdown Voltage	400			V	$V_{GS} = 0\text{V}$ , $I_D = 1.0\text{ mA}$ ,
$R_{DS(on)}$ Static Drain-to-Source On-State Resistance	—	—	0.315		$V_{GS} = 10\text{V}$ , $I_D = 9.0\text{ A}$ <sup>3</sup>
	—	—	0.415		$V_{GS} = 10\text{V}$ , $I_D = 14\text{ A}$ <sup>3</sup>
$V_{GS(th)}$ Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$
$I_{DSS}$ Zero Gate Voltage Drain Current	—	—	25	$\mu\text{A}$	$V_{DS} = 320\text{ V}$ , $V_{GS} = 0\text{V}$
	—	—	250		$V_{DS} = 320\text{ V}$ , $V_{GS} = 0\text{V}$ , $T_J = 125^\circ\text{C}$
$I_{SS}$ Gate -to-Source Leakage Forward	—	—	100	nA	$V_{GS} = 20\text{ V}$
$I_{SS}$ Gate -to-Source Leakage Reverse	—	—	-100	nA	$V_{GS} = -20\text{ V}$
$Q_{G(on)}$ On-state Gate Charge	—	—	110	nC	$V_{GS} = 10\text{ V}$ , $I_D = 14\text{ A}$
$Q_{GS}$ Gate-to-Source Charge	—	—	18	nC	$V_{DS} = 200\text{ V}$
$Q_{GD}$ Gate-to-Drain ("Miller") Charge	—	—	65	nC	See note 4
$t_{ON}$ Turn-On Delay Time	—	—	35	ns	$V_{DD} = 200\text{ V}$ , $I_D = 9\text{ A}$ , $R_G = 2.35$ See note 4
$t_r$ Rise Time	—	—	190	ns	
$t_{OFF}$ Turn-Off Delay Time	—	—	170	ns	
$t_f$ Fall Time	—	—	130	ns	

Source-Drain Diode Ratings and Characteristics

Parameter	Min.	Typ.	Max.	Units	Test Conditions
$V_{SD}$ Diode Forward Voltage	—	—	1.7	V	$T_J = 25^\circ\text{C}$ , $I_S = 14\text{ A}$ <sup>3</sup> , $V_{GS} = 0\text{ V}$
$t_r$ Reverse Recovery Time	—	—	1200	ns	$T_J = 25^\circ\text{C}$ , $I_R = 14\text{ A}$ , $di/dt \leq 100\text{ A}/\mu\text{s}$

Thermal Resistance

Parameter	Min.	Typ.	Max.	Units	Test Conditions
$R_{thJC}$ Junction-to-Case	—	—	0.83	$^\circ\text{C}/\text{W}$	Mounting surface flat, smooth, and greased
$R_{thCS}$ Case-to-sink	—	0.21	—		
$R_{thJA}$ Junction-to-Ambient	—	—	48		

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. @  $V_{DD} = 50\text{V}$ , Starting  $T_J = 25^\circ\text{C}$ ,  $L \geq 6.25\text{ mH}$ ,  $R_G = 25$ , Peak  $I_L = 14\text{A}$
3. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; Duty Cycle  $\leq 2\%$
4. See MIL-S-19500/592

2N7224, JANTX2N7224, JANTXV2N7224  
2N7225, JANTX2N7225, JANTXV2N7225

2N7227, JANTX2N7227, JANTXV2N7227  
2N7228, JANTX2N7228, JANTXV2N7228

ABSOLUTE MAXIMUM RATINGS ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

Parameter	JANIXV, JANIX, 2N7228	Units
$I_D$ @ $V_{GS} = 10\text{V}$ , $T_C = 25^\circ\text{C}$ Continuous Drain Current	12	A
$I_D$ @ $V_{GS} = 10\text{V}$ , $T_C = 100^\circ\text{C}$ Continuous Drain Current	8.0	A
$I_{DM}$ Pulsed Drain Current <sup>1</sup>	48	A
$P_D$ @ $T_C = 25^\circ\text{C}$ Maximum Power Dissipation	150	W
Linear Derating Factor	1.2	W/ $^\circ\text{C}$
$V_{GS}$ Gate-Source Voltage	$\pm 20$	V
$E_{AS}$ Single Pulse Avalanche Energy <sup>2</sup>	750 <sup>4</sup>	mJ
$I_{AR}$ Avalanche Current <sup>1</sup>	12 <sup>4</sup>	A
$E_{ARR}$ Repetitive Avalanche Energy <sup>1</sup>	15 <sup>4</sup>	mJ
$T_J$ Operating Junction	-55 to 150	$^\circ\text{C}$
$T_{STG}$ Storage Temperature Range		$^\circ\text{C}$
Lead Temperature	300(.06 from case for 10 sec)	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS @  $T_J = 25^\circ\text{C}$  (Unless Otherwise Specified)

Parameter	Min.	Typ.	Max.	Units	Test Conditions
$BV_{DSS}$ Drain-Source Breakdown Voltage	500			V	$V_{GS} = 0\text{V}$ , $I_D = 1.0\text{ mA}$ ,
$R_{DS(on)}$ Static Drain-to-Source On-State Resistance	—	—	0.415		$V_{GS} = 10\text{ V}$ , $I_D = 8.0\text{ A}$ <sup>3</sup>
	—	—	0.515		$V_{GS} = 10\text{ V}$ , $I_D = 12\text{ A}$ <sup>3</sup>
$V_{GS(th)}$ Gate Threshold Voltage	2.0	—	4.0	V	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$
$I_{DSS}$ Zero Gate Voltage Drain Current	—	—	25	$\mu\text{A}$	$V_{DS} = 400\text{ V}$ , $V_{GS} = 0\text{ V}$
	—	—	250	$\mu\text{A}$	$V_{DS} = 400\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125^\circ\text{C}$
$I_{GSS}$ Gate -to-Source Leakage Forward	—	—	100	nA	$V_{GS} = 20\text{ V}$
$I_{RSS}$ Gate -to-Source Leakage Reverse	—	—	-100	nA	$V_{GS} = -20\text{ V}$
$Q_{g(on)}$ On-state Gate Charge	—	—	120	nC	$V_{GS} = 10\text{ V}$ , $I_D = 12\text{ A}$
$Q_{GS}$ Gate-to-Source Charge	—	—	19	nC	$V_{DS} = 250\text{ V}$
$Q_{GD}$ Gate-to-Drain ("Miller") Charge	—	—	70	nC	See note 4
$t_{b(on)}$ Turn-On Delay Time	—	—	35	ns	$V_{DD} = 250\text{ V}$ , $I_D = 8\text{ A}$ , $R_G = 2.35$
$t_r$ Rise Time	—	—	190	ns	See note 4
$t_{b(off)}$ Turn-Off Delay Time	—	—	170	ns	
$t_f$ Fall Time	—	—	130	ns	

Source-Drain Diode Ratings and Characteristics

Parameter	Min.	Typ.	Max.	Units	Test Conditions
$V_{SD}$ Diode Forward Voltage	—	—	1.7	V	$T_J = 25^\circ\text{C}$ , $I_S = 12\text{ A}$ <sup>3</sup> , $V_{GS} = 0\text{ V}$
$t_r$ Reverse Recovery Time	—	—	1600	ns	$T_J = 25^\circ\text{C}$ , $I_R = 12\text{ A}$ , $di/dt \leq 100\text{ A}/\mu\text{s}$

Thermal Resistance

Parameter	Min.	Typ.	Max.	Units	Test Conditions
$R_{thJC}$ Junction-to-Case	—	—	0.83	$^\circ\text{C}/\text{W}$	Mounting surface flat, smooth, and greased
$R_{thCS}$ Case-to-sink	—	0.21	—		
$R_{thJA}$ Junction-to-Ambient	—	—	48		

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. @  $V_{DD} = 50\text{V}$ , Starting  $T_J = 25^\circ\text{C}$ ,  $L \geq 94\text{ mH}$ ,  $R_G = 25$ , Peak  $I_L = 12\text{A}$
3. Pulse width  $\leq 300\text{ }\mu\text{s}$ ; Duty Cycle  $\leq 2\%$
4. See MIL-S-19500/592

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